FDTD simulations of transmission increase in corrugated tip of near-field scanning optical microscope

Aday Shomanov, Zhandos Yessenbayev, Arshat Urazbaev, Bakhyt Matkarimov

National Laboratory Astana, Kabanbay batyr avenue, 53

E-mail: *adai.shomanov@nu.edu.kz*

This paper studies mechanisms of nano-focusing and transport of energy of a light through a tip with a sub-wavelength aperture diameter for scanning near-field optical microscopy (NSOM). In particular, we considered the problem of increasing the transmission of energy through the tip of the microscope. One way to improve transmission is to create a periodic metal-dielectric interface, which provides a coupling effect of the plasmon-polariton waves propagating at the boundary of the interface.

A similar problem of investigating transmission at the tip of a scanning optical near-field microscope is considered in [2-4]. The methods proposed in these studies are also based on changing the surface structure of the tip. At the same time, in [5], the increase in transmission is achieved by additional layering of gold (Au) on the tip of the NSOM aperture.

Basic configuration of the probe consists of an outer metal coating and silicon dioxide core (SiO_2). We modify this basic configuration by changing the surface structure of the metal-dielectric interface by adding trapezoidal corrugations (Fig. 21). These elements form the boundary of the metal-dielectric surface in our model.

As a result of simulations we were able to see almost twofold increase in the maximum value of the transmission for the model with corrugations compared to the model with a smooth boundary.

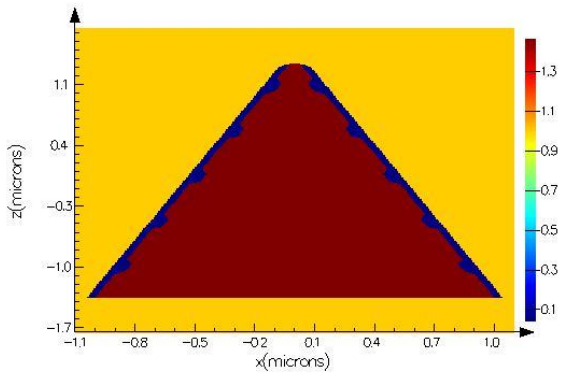

Fig. 21 Microscope tip model with periodic corrugation

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[3] Yuan Wang, Werayut Srituravanich, Cheng Sun, and Xiang Zhang, *Nano Letters* **2008** *8* (9), 3041-3045, DOI: 10.1021/nl8023824

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